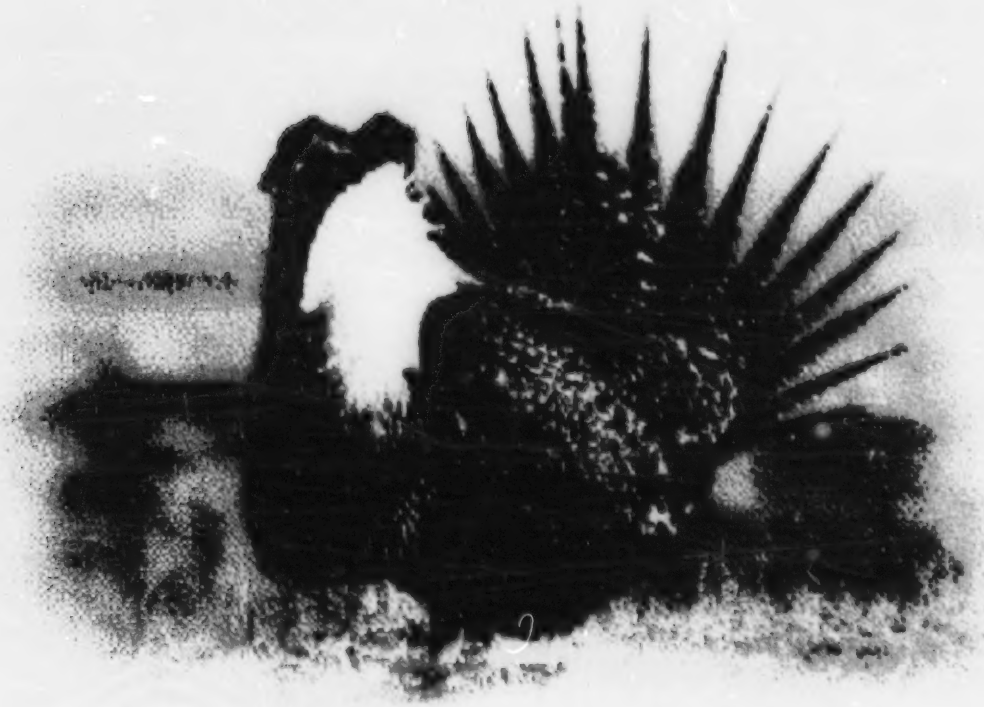
CANADIAN SAGE GROUSE RECOVERY STRATEGY



July 2001

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Saskatchewan
Environment
and Resource
Management

CANADIAN SAGE GROUSE RECOVERY STRATEGY

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PREFACE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed sage grouse in Canada as threatened in 1997 and, after further review, changed the status to endangered in 1998. The provinces of Saskatchewan and Alberta jointly formed a Sage Grouse Recovery Team outside of the Recovery of Nationally Endangered Wildlife Committee (RENEW) process in November 1997. The Recovery Team is composed of representatives from government (provincial and federal), land managers, landowners, conservation organizations and industry from Saskatchewan and Alberta. Although outside of the RENEW process, the Recovery Team adopted the evolving RENEW concept for development of recovery plans. This Recovery Strategy reviews the background and status of sage grouse in Canada, establishes goals and objectives and provides recommended strategies for population recovery. The Recovery Team will coordinate the activities of Working Groups established in February 2000 who will develop Action Plans which will focus on implementation and program delivery.

EXECUTIVE SUMMARY

Sage grouse (*Centrocercus urophasianus*) in North America historically occurred in sixteen states and three provinces. The subspecies *C. u. urophasianus* occurred throughout the Great Plains while *C. u. phaios* occurred in the western coastal states and British Columbia. Recently, a separate species, *Centrocercus minimus*, has been recognized in southwestern Colorado and southeastern Utah.

Sage grouse populations have exhibited significant decline throughout their range in North America. They are considered extirpated in five states (Arizona, Kansas, Nebraska, New Mexico and Oklahoma) and British Columbia. Within Canada, sage grouse only occur in the southwestern portion of Saskatchewan and southeastern Alberta. Numbers of sage grouse have never been high in these two provinces, with less than 1% of the total North American population occurring in Canada. Sage grouse populations are monitored by counting males in the spring during their breeding displays on leks (dancing or strutting grounds). In Alberta, numbers of displaying males have declined from about 600 in 1967, to 400 in 1987, and 122 in 1997. In Saskatchewan, counts of males have dropped from 515 males in 1987 to 61 males in 1997. Numbers of males in the two provinces have declined 80% from 1987 to 1997 (915 to 183). A corresponding decline of 80% has been estimated for the total spring population over the same period (4067 to 813). In addition to the decrease in number of grouse, the number of active leks being used by grouse has also declined by 56% (43 leks in 1987 to 19 leks in 1997). The current population of sage grouse in Canada is precarious and may be at, or very near, the minimum level for sustaining a viable population.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed sage grouse in Canada as 'threatened' in 1997 and upgraded the listing to 'endangered' in 1998. The COSEWIC officially lists sage grouse as extirpated in British Columbia. Sage grouse are at the northern limit of their range in the southern prairie provinces. The species was listed as threatened in Saskatchewan in 1987 and, in 1999, was listed as endangered under Saskatchewan's Species at Risk revisions of *The Wildlife Act*. In Alberta, the Status of Wildlife in Alberta report (1996) included sage grouse on the 'blue list' of species which may be at risk. The Alberta Endangered Species Conservation Committee has recently recommended that sage grouse be included on the list of endangered animals under the Alberta *Wildlife Act*, and that listing occurred early in 2000.

Sage grouse exhibit an obligate relationship with the sagebrush-grassland complex of the semi-arid mixed-grass prairie of Alberta and Saskatchewan. They are totally dependent on sagebrush habitat as a source of food and shelter. The range inhabited by sage grouse has decreased considerably from the 1960's to the present as land-use patterns and habitat conditions were altered.

The cause for the decline in sage grouse numbers is not known. Survival of sage grouse on the remaining range is complicated by a number of factors which are shared by other species at risk within the prairie ecosystem. Essentially the remaining native prairie habitat is allocated to agricultural use, principally livestock grazing. Oil and gas exploration results in establishment of

well sites, pipelines, pumping stations, power lines and access roads throughout the range. Wildlife viewing enthusiasts frequent some of the more obvious leks for opportunities to view and photograph displaying males. The effects of climate change and potential future climate change are unmeasured. The extent of interspecific competition between sage grouse and other species is poorly understood. Predator complexes may have changed substantially from historic periods and there is a poor understanding of predator-prey relationships within the prairie ecosystem. The combination of factors which may potentially impact sage grouse and the interrelationships between these factors are complex.

This Sage Grouse Recovery Strategy has been developed by a Sage Grouse Recovery Team composed of representatives of governments, stakeholders and land users from Saskatchewan and Alberta. The document provides an overview of sage grouse ecology and population status, establishes population recovery goals and provides recommended strategies for recovery. The Sage Grouse Recovery Team has initiated the formation of Working Groups to develop Action Plans to convert recommended strategies into initiatives and activities directed at accomplishing recovery goals and objectives.

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I. GOAL AND PRIMARY OBJECTIVES

The goal of this recovery strategy is to recommend measures which will enable the sage grouse population in Alberta and Saskatchewan to recover to self-sustaining levels so that the species is not threatened or endangered.

The primary objective of this recovery strategy is to recommend strategies to:

1. conserve, secure and enhance critical habitat required by sage grouse in Alberta and Saskatchewan;

2. reverse the declining trend in numbers of sage grouse and active sage grouse leks in Alberta and Saskatchewan;

3. maintain a stable or increasing sage grouse population with greater than 365 males in the spring in Alberta (1968–1989 average) and greater than 500 males in the spring in Saskatchewan, and;

4. maintain active sage grouse lek numbers at or greater than 16 in Alberta (1968–1989 average) and 30 in Saskatchewan.

II. BACKGROUND AND STATUS EVALUATION

A. Biological considerations

a. Taxonomic position

Sage grouse are included in the Order Galliformes, which includes grouse, quail, partridges, turkeys, pheasants and ptarmigans. They are members of the Family Tetraonidae with ptarmigan and other grouse (Godfrey, 1979).

Sage grouse were officially described and given the taxonomic name *Tetrao urophasianus* in 1828 (Bonaparte, 1828). The name was revised to *Centrocercus urophasianus* in 1831; two subspecies were then recognized, *C. u. urophasianus* and *C. u. phaios*) (Aldrich, 1963). As a result of work in Colorado, another revision recognizing the Gunnison sage grouse *(Centrocercus minimus*) as a full species has been proposed (Braun, pers. comm.).

b. Ecological role

Sage grouse, the largest grouse in North America, are year-round residents of the sagebrush range of the semi-arid mixed-grass prairie regions of southeastern Alberta and southwestern Saskatchewan. Sage grouse are totally dependent on sagebrush as a source of food and shelter (Patterson, 1952; Schroeder et al., 1999). The obligate relationship with the sagebrush-grassland complex makes sage grouse a good indicator of the health of this ecosystem. The relative abundance of sage grouse may be reflective of the integrity and quality of habitat provided by the ecosystem.

Sage grouse food consists primarily of sagebrush leaves, supplemented at various life stages by forbs and insects, within the sagebrush-grassland community. In turn, the sage grouse is a potential prey species for several predators. Although there is no documented evidence of specific predators targeting sage grouse, coyotes, foxes and raptors may opportunistically prey on sage grouse adults and chicks. There are also a host of predators (skunks, raccoons, foxes, coyotes, ground squirrels, badgers, corvids) which are known to prey upon eggs of ground-nesting birds. There is no doubt that some of these species prey upon sage grouse nests.

c. Status of populations

In 1997, COSEWIC first reviewed sage grouse status and assigned a threatened status. Following further review, COSEWIC upgraded this status to endangered in 1998, indicating that sage grouse in Canada are considered a species facing imminent extirpation.

Provincially, Saskatchewan listed sage grouse as a threatened species in 1987 based on a declining population and reduction in range. In 1999 they were officially uplisted to endangered. In a 1996 review of the status of Alberta wildlife, sage grouse were included on the 'blue list' of species which may be at risk (Alberta Environmental Protection, 1996). This designation was assigned due to the limited distribution of the species,

declining populations, and specific habitat requirements. In 1997, the species was officially designated as extirpated in British Columbia.

d. Population trends

The simplest way to obtain population estimates for sage grouse is through the use of lek[1] counts. Lek counts are simply the enumeration of all male sage grouse displaying on a dancing ground during the mating season. The maximum number of males observed on each lek is then used as an index of population status and to estimate overall population size (Beck and Braun, 1980).

In Alberta, lek counts have been performed on an irregular basis since 1968 and in Saskatchewan since 1987 (Appendix 1 and 2). In the late 1960s, counts in Alberta showed an average of about 600 males. The number of males observed dropped somewhat during the 1970s, rose to a peak of 524 males in 1981, remained relatively stable until the late 1980s after which they again declined. However, for many of these annual counts, not all known leks were surveyed and, in some years, it is unclear which leks were surveyed (Aldridge, 1998). Saskatchewan began lek counts in 1987 and counted a total of 515 males on 30 active grounds (Weichel and Hjertaas, 1992), comparable to the 400 males counted in Alberta on 13 active grounds (Aldridge, 1998).

Based on 1987 lek count data from Alberta and Saskatchewan, the Canadian spring sage grouse population for 1987 was estimated at 2745 to 4067 individuals[2]. The growing concern for the Canadian sage grouse population resulted in more intensive survey efforts in both provinces from 1994 to 1999. Lek counts indicated that the Canadian sage grouse population was at an all time low in 1997 with 122 cocks counted on 8 active leks in Alberta and only 61 cocks on 11 active leks in Saskatchewan. This resulted in a 1997 Canadian spring sage grouse population estimate of 549 to 813 individuals with only 19 active strutting grounds (Aldridge, 1998). The Canadian sage grouse population declined by 80% from 1987 to 1997. The spring lek counts increased to 124 and 144 males respectively for Alberta and Saskatchewan in 1998, which resulted in a Canadian estimate of 873 to 1293 individuals on 20 active leks. This rebound was likely due to increased over-winter survival related to the mild winter and lack of snow cover. The 1999 counts showed similar numbers to those of 1998.

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[1] *A traditional Scandinavian name for a site used by males for epigamic (intersexual and intrasexual) display. Originally used in Sweden to describe black grouse and ruff arenas, but now much more widely applied to birds, other vertebrates, and even some invertebrate mating assemblages (Johnsgard, 1994). In North America, leks are sometimes referred to as dancing grounds or arenas.*

[2] *These estimates are based on the following assumptions: an average spring sex ratio of 2 hens for every cock, that counts may represent as few as 75% of all cocks associated with that lek due to the inability of yearling cocks to obtain territories, and that 90% of all active leks are located and surveyed (C. Braun in Aldridge, 1998).*

e. Current and past distribution

i. North America

Sage grouse and sagebrush have a similar distribution in North America, both found in at least sixteen states and three provinces. Until recently two subspecies of sage grouse were recognized, *Centrocercus urophasianus urophasianus* of the Great Plains/Rocky Mountains and *C. u. phaios* of the western mountains (Aldrich, 1963).

The Northern Great Plains race (*C. u. urophasianus*) was distributed historically through western Nebraska, North Dakota, South Dakota, northwestern Colorado, most of Montana, Idaho, Wyoming, Nevada, Utah, northwestern New Mexico, Oklahoma, Alberta and Saskatchewan (Girard, 1935; Girard, 1937; Western States sage grouse Technical Committee (WSSGTC), 1995), and possibly western Kansas and eastern Arizona (Eustace, 1996). Sage grouse are now considered extirpated in the states of Arizona, Kansas, Nebraska, New Mexico, and Oklahoma (WSSGTC, 1995; Braun, 1998).

The western *C. u. phaios* was found in eastern Washington, British Columbia, Oregon, and California. The British Columbia population is extirpated. In Oregon, the introduction of *C. u. urophasianus* has resulted in some birds which are intermediate in form (Braun, pers. comm.).

Gunnison's sage grouse, *C. minimus*, are most common in southwestern Colorado, in particular the Gunnison Basin area, and in southeastern Utah. The recently extirpated populations in Oklahoma and Arizona were also likely *C. minimus* (Braun, pers. comm.).

ii. Canada

As in the United States, sage grouse in Canada are closely associated with sagebrush habitats. Two types of Sagebrush occur in the Canadian range, Big Sagebrush (*Artemisia tridentata*) in British Columbia and Silver Sagebrush (*A. cana*) in the prairies. *C. u. phaios* inhabited the Okanagan and Similkameen Valleys of Britsh Columbia until 1918 but are now considered extirpated (Cannings et al., 1987). *C. u. urophasianus* is the only subspecies of sage grouse which occurs in Canada, where it is at the northern limit of its range in southern Alberta and Saskatchewan.

iii. Alberta

Due to the species' year-round association with sagebrush, the distribution of sage grouse often follows the distribution of sagebrush. Historical records and anecdotal information indicate that sage grouse once occurred in suitable habitat as far northeast as Elkwater (Armstrong, 1968) and the Walsh Flats (Mitchell, 1959; Banasch, 1985), extending north of Medicine Hat along the South Saskatchewan River as far as Empress. This range extended to the west just north of Brooks (Sadler and Myers, 1976), and south to Champion, likely including the Lethbridge area (Figure 1). This historical range encompassed an area of approximately 49,000 km^2 in Alberta (Aldridge, 1998). Currently, sage grouse are isolated to the extreme

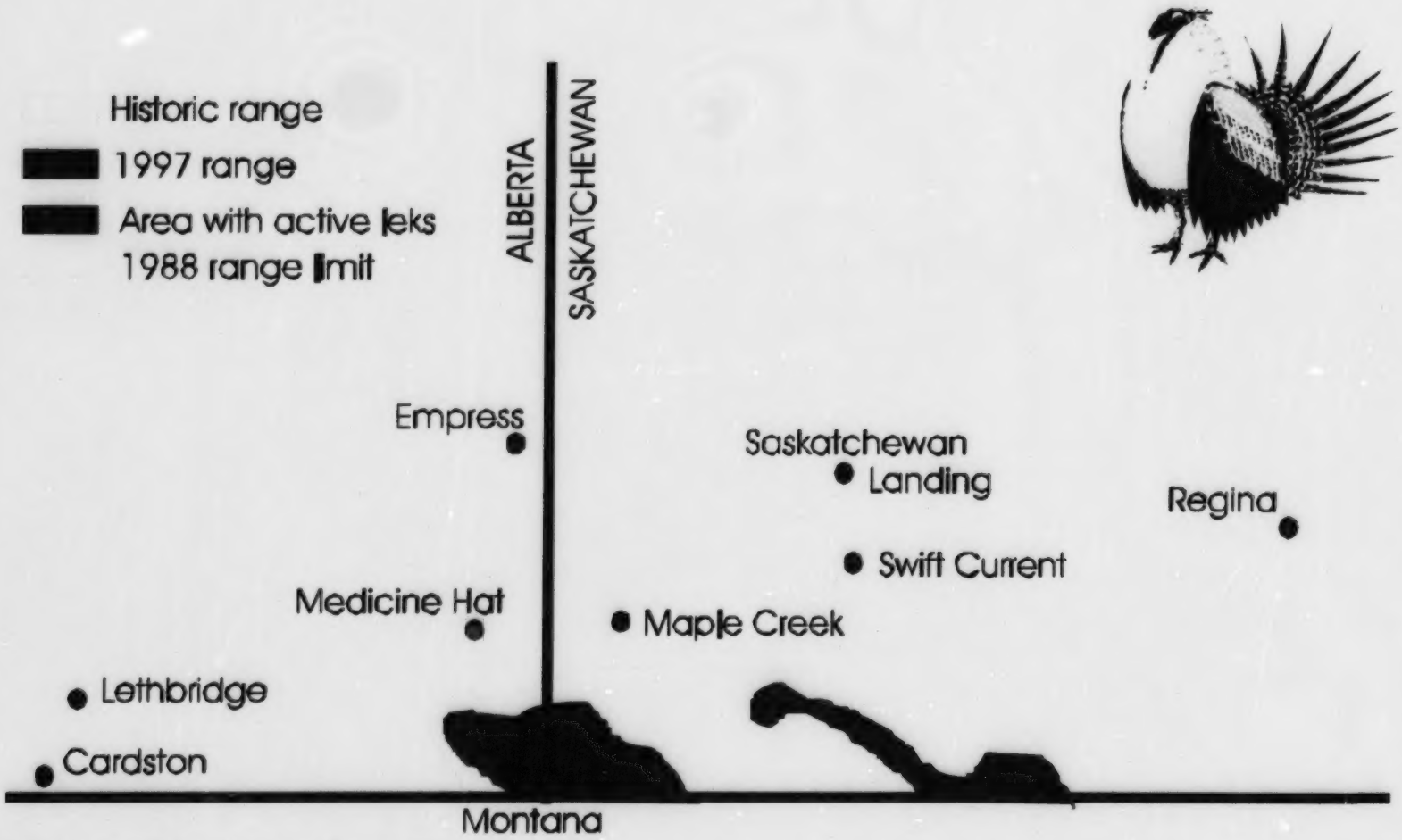

Figure 1. Distribution of Sage Grouse in Prairie Canada

southeastern corner of the province, centered south and east of the town of Manyberries. This 4000 km^2 area contains extensive native prairie and sagebrush flats which forms unique habitat for sage grouse (Aldridge, 1998).

iv. Saskatchewan

Based on anecdotal information, sage grouse were historically found north to the South Saskatchewan River from the Alberta border (Empress) eastward to near Elbow. The eastern-most records are from the Big Muddy Valley. The last records from the edges of the range are from the 1960s and early 1970s. One of the last confirmed northern records was one shot in 1965 near Anerley, south of Rosetown (Roy, 1996). By 1988 the range had contracted to the area south of the Cypress Hills escarpment, eastward to the Killdeer area (Harris and Weidl, 1988). In the 1990s the range was further reduced with sage grouse now restricted to three distinct areas (Figure 1);

1. the extreme southwest corner (from south of Divide north westward to north of Govenlock);
2. the Frenchman River Valley from south of Shaunavon to the Montana border, and;
3. the Killdeer Badlands.

f. Proportion of breeding population in Canada

The present size of the breeding population of sage grouse in North America is unknown. However, based on lek counts performed in the eleven states and two provinces where sage grouse exist, Braun (1998) suggests a range-wide estimate for the spring of 1998 of about 157,000 sage grouse. The 1998 Canadian spring sage grouse population was estimated at 873-1293 individuals (Aldridge, 1999). Thus, the Canadian sage grouse population comprises less than one percent of the remaining sage grouse in North America.

g. Incidence of disease and pests

Sage grouse are affected by a variety of diseases and pests including chewing lice (*Lagopoecus gibsoni*, *L. perplexus* and *Goniodes centrocerci*) and avian malaria (Table 1). Both have implications for adult and juvenile survival and hence, have reproductive implications. Males who are hosts to these organisms are less likely than healthy males to be selected as mates by healthy adult females (Boyce, 1990). Subadult males (Eng, 1963) and diseased birds (Johnson and Boyce, 1991) have lower reproductive success than mature and healthy birds. Although sage grouse are known to be hosts to a number of parasites in Saskatchewan, the most significant parasite of juvenile sage grouse is the tapeworm (*Raillietina centrocerci*), which can be a factor in juvenile mortality (Kerwin, 1971).

Table 1: Diseases and parasites of sage grouse		
Sarcocytes riyeli	Protozoan	Large numbers found in two Alberta sage grouse. Infection of young is greater than in adults. **No deleterious effect was noted in these birds** (Salt, 1958). More prevalent during summer, numbers reduced in fall and winter. Cannot parasitize humans (Thorne et al. 1982).
Eimeria angusta	Protozoan	Probably occur wherever sage grouse occur (Thorne et al. 1982). **This genus has been known to decimate sage grouse populations in several localities**; 400 of 2000 sage grouse died of it in Fremont Co. Wyoming (Simon, 1940). Outbreaks occur during summer when birds concentrate near water and are reduced in fall when dispersal occurs (Wallestad, 1975).
Eimeria centrocerci	Protozoan-coccidium	Found in small numbers in Fremont Co. Wyoming. **No details on effects were noted** (Simon, 1940). Found in droppings of two of 153 sage grouse in Moffat Co. Colorado (Stabler et al, 1981).
Leucocytozoon	protozoan	**Some acutely infected birds will die. Those recovering may never regain full health** (Thorne et al, 1982).
Histomonas meleagidis	protozoan	Carried by *Heterakis gallinarium* eggs and causes avian blackhead. **Blackhead can result in high mortality; however free-ranging birds are only infrequently affected** (Thorne et al, 1982).
Trypanosoma	Flagellate	can infect many species including sage grouse (Thorne et al, 1982).
Plasmodium pediocetti	virus, Avian Malaria	Causes morning eruption of erythrocytes releasing metabolic wastes and haemotoxins into the bloodstream (Stabler and Kitzmiller, 1976). Coincides with morning courtship display and suggests infected males feel poorly when they would be strutting to attract females. Females preferentially mate with males with low parasite loads (Johnson and Boyce, 1991). **Infected males have significantly lower reproductive success**; attend leks less frequently, copulate less frequently, and their mates are younger and in poorer condition than non-infected males (Boyce, 1990).
Trichomonal sp.		Found in vast numbers in coecal counts of every sage grouse examined. **It appears to be harmless** (Simon, 1940).
Cheilospirura (Acuarina) centrocerci	Nomatode	Were found in an immature state in gizzards of young sage grouse. Produces necrosis in horny gizzard tissue and underlying muscles may also have hemorrhage. **General health not seriously affected** (Simon, 1940).
Raillietina centrocerci	Nematode	The most common macroscopic parasite of sage grouse often causing the small intestine to distend. **No serious ill effects were noted** (Simon, 1940). **Sage grouse with heavy infestations appear in good health** (Autenreith, 1986). Heavy infestations in Saskatchewan. Present even in one week old sage grouse. **Kerwin (1971) felt the role of this parasite is overlooked as a mortality factor.**

Table 1: Diseases and parasites of sage grouse		
Habronema urophasianus	Nematode	Found in the gizzards of 15 Wyoming and in Montana sage grouse. Associated with E. centrocerci and **pathogeny could not be determined** (Simon, 1940).
Heterakis gallinae (gallinarum)	Nematode	Cecal worm of sage grouse. **Worm eggs may carry Protozoan *Histomonas meleagridis* which causes Avian Blackhead in sage grouse.** Large numbers of worms may cause edema, fibrosis, and hemorrhage. **Direct effects of the worm itself are usually mild.** The species is only occasionally seen in Wyoming and **the threat of transmission is remote** (Thorne et al, 1982).
Hymenolepis microps	Cestoda	Incorrect identification by Deidy. Corrected based on genital pores and armiture as Rhabdometra sp. (Simon, 1940).
Haemaphysalis cinnabara	Acarina (ticks)	**A vector of *Bacterium tularense* (Tularemia).** Ticks were found in such numbers that they were likely a great nuisance to sage grouse. Fergus Co. Montana sage grouse were heavily infested. H. Leporus-palustris was found in a Fergus Co. sage grouse (Simon, 1940). **Causes tick paralysis but is not known to transmit disease** (Thorne et al, 1982).
Goniodes centrocerci *Lagopoecus gibsoni* *L. perplexus*	Chewing Lice, Order Mallophaga Suborder Ischnocera	79 specimens found in Wyoming (Simon, 1940). Three species eat skin and feathers. Distribution may be wider than records indicate (Thorne et al, 1982). **Males with louse induced hematomas on their air sacs which females can detect are avoided as mates (Boyce, 1990).** Only 13.8% of lousy males were successful breeders whereas 43% of non-lousy males were breeders (Spurrier et al, 1991).
Mites		Found on sage grouse but are **unimportant to the health of their host** (Simon, 1940 cited in Autenreith, 1986).
Salmonellosis, botulism, Limberneck		**May be important to sage grouse** (Thorne, 1969 cited in Autenreith, 1986).
Dissolved Solids in Water		[3807ppm] is **toxic to sage grouse** (Autenreith, 1986).

B. Habitat considerations

a. United States (Big Sagebrush)

Sage grouse are dependent on sagebrush for survival during all seasons of the year (Hagen, 1999). Studies in United States jurisdictions indicate that sage grouse require a variety of sagebrush habitats during various stages of their life cycle. Mating areas on leks generally have very sparse vegetation (<26% ground cover) with sparse (7% cover) and short sagebrush (<10 cm) (Peterson, 1980). Areas near leks which are used by adults for daytime loafing and feeding consist of taller (15-30 cm) sagebrush (Peterson, 1980). Nests are almost always under tall sagebrush plants (27-76 cm) (Peterson, 1980). Successful nests are also associated with tall (>18 cm), dense (31% cover) residual grass cover at nest sites (Delong and Crawford, 1993; Gregg et al., 1994).

Broods use areas that have lower shrub density (<31% cover) where forbs and insects are more prevalent. Hens with broods do not use denser stands, probably because fewer forbs are present. Adult hens with broods move to moist areas which support succulent vegetation (Wallestad, 1975).

During winter, sage grouse distribution is influenced by topography, variation in snow depth and exposure of sagebrush above snow (Hupp and Braun, 1989). Structurally, winter sage grouse habitat is similar to the areas around leks which are used for loafing and feeding (20-30% canopy cover) (Wallestad and Schladweiler, 1974; Wallestad 1975). During periods of deep snow cover, birds will move into areas that contain the tallest sagebrush plants. They tend to seek out wintering areas which have south or southwest facing slopes where more sagebrush may be exposed above the snow (Hupp and Braun, 1989).

b. Prairie Canada (Silver Sage)

In the dry mixed-grass ecoregion of southeastern Alberta and southwestern Saskatchewan, sage grouse habitat is limited to the distribution of Silver Sagebrush (*A. cana*), which, in prairie Canada, is generally most abundant in riparian corridors. Silver Sagebrush is the principal food source for adult grouse during the summer and probably throughout the year (Table 2). It also provides necessary escape and thermal cover in grasslands, much of which offer relatively little topographical relief for shelter or concealment. During the summer, sage grouse broods use a greater variety of legumes and forbs, and more insects than adults do (Table 3). It is interesting to note that several of the non-grass species utilized by sage grouse in Saskatchewan (Table 2 and 3) are documented increasers or weedy invaders which are more prevalent under increased grazing intensity (Wroe et al. 1988). There is a need for further study of the relationship between livestock grazing intensity and grazing patterns and the availability of habitat and food for sage grouse.

Weichel and Hjertaas (1992), McAdam (1997), Hyslop, (1998) and Aldridge (1998) have summarized seasonal habitat requirements for sage grouse recently from reviews of the literature. However, these sources do not provide explicit detail with respect to seasonal habitat requirements for sage grouse in Silver Sagebrush habitat in Alberta and Saskatchewan. For that reason, the following description of habitat requirements for

Table 2. Spring/summer food items for adults sage grouse in southern Saskatchewan (Kerwin, 1971)			
Species	**Common Name**	**% Volume**	**% Frequency**
Artemisia cana	Silver Sagebrush	47	73
Artemisia frigida	Pasture Sage	26	73
Medicago sativa	Alfalfa	7	45
Tragopogon dubius	Goatsbeard	3	36
Melilotus spp.	Sweet Clover	4	27
Phlox hoodii	Moss Phlox	tr	27
Gramineae	Grass	2	18
Taraxacum officinale	Dandelion	1	18
Achillea millefolium	Yarrow	1	9
Antennaria spp.	Pussytoes	tr	9
Total Plant		**92**	**100**
Hymenoptera	Grasshopper	2	27
Coleoptera	Beetle	4	18
Immature insects		tr	18
Others		1	9
Total animal		**8**	**64**

various life stages relies on data provided by studies in both Canada and the United States. Readers are cautioned that much of the data correlating seasonal activity with habitat characteristics is derived from research with Big Sagebrush (*A. tridentata*) communities in regions of greater altitudinal variation than occurs in prairie Canada. In east central Montana, a region which more closely resembles the Canadian plains, winter and summer ranges tend to overlap. The extent of seasonal movements among habitats is not well documented in Alberta and Saskatchewan although recent work by Aldridge (2000) does provide some insight into habitat use by sage grouse in Alberta.. General seasonal habitat requirements for sage grouse are summarized as follows:

i. Breeding

Open relatively level areas of short or sparse vegetation near sagebrush flats are required for leks, where displaying males are readily visible to females (and to each other). These typically range from 0.04 ha to greater than 1 ha in size and are in native grassland near watercourses (Dalke et al., 1963; Weichel and Hjertaas 1992). Sagebrush density within a radius of 3.2 km of 25 known leks in Alberta ranged from light (3-10 plants per 61 m transect) to heavy (>25 plants per 61 m transect) (Clark and Dube, 1984).

ii. Nesting

In Montana, most nests (68%) were found to be located within 2.5 km of a lek (Wallestad and Pyrah, 1974) but studies in the Oregon desert have shown nests to be as far as 12 km from the nearest lek (Hanf et al., 1994). Connelly et al. (1988) found that distance from nest to lek ranged up to 6 km. In Alberta, Aldridge (2000) found an average lek to nest distance of 4.7 km, ranging from 0.42 to 15.45 km. Nest concealment requires both vertical and horizontal cover from sagebrush of different heights with good inter-sagebrush growth of grasses and forbs (Weichel and Hjertaas, 1992; Madsen, 1995; Patterson, 1952; Wallestad and Pyrah, 1974; Klebenow, 1969). Aldridge (2000) found that nearly 90% of sage grouse nests were located under silver sagebrush and understory grass cover that was taller than average. Forbs are an important food source for pre-laying hens (Hanf et al., 1994; Barnett and Crawford, 1994).

iii. Brood rearing

In Saskatchewan, hens with broods were found to make limited movements, up to a few hundred metres, from nest sites (Weichel and Hjertaas, 1992). Hens with broods concentrate in more open and moist sagebrush grasslands where succulent forbs and a greater variety of insects are plentiful (Banasch, 1985; Drut et al., 1994; Klebenow, 1969; Patterson, 1952; Wallestad, 1971)(Table 3). Proximity to water is likely of greater importance in drought years as meadows with available surface water have been shown to be preferred by sage grouse (Oakleaf, 1971). Hens and broods may move further from sagebrush flats into wet meadow areas in search of forbs near open water during late summer (Drut et al., 1994; Klebenow, 1969; Patterson 1952; Wallestad, 1971). In Alberta, Aldridge (2000) did not find any noticeable shift of sage grouse into mesic habitat and concluded

Table 3. Spring/summer food items for juvenile sage grouse in southern Saskatchewan (Kerwin, 1971)			
Species	Common Name	% Volume	% Frequency
Lepidium densiflorum	Peppergrass	6	51
Tragopogon dubius	Goatsbeard	22	62
Taraxacum officinale	Dandelion	3	20
Medicago sativa	Alfalfa	20	33
Melilotus spp.	Sweet Clover	7	25
Artemisia frigida	Pasture Sage	10	57
Achillea millefolium	Yarrow	2	18
Lactuca pulchella	Wild Blue Lettuce	6	12
Plantago elongata	Lance-leaved Plantain	3	14
Astragalus spp.	Milk-vetch	0	5
Phlox hoodii	Moss Phlox	1	7
Erigeron spp	Fleabane	0	4
Sonchus arvensis	Sow Thistle	0	2
Artemisia cana	Silver Sagebrush	1	5
Shepherdia argentea	Silver Buffaloberry	3	2
Amelanchier alnifolia	Saskatoon Berry	0	14
Gramineae	Grass	1	5
Unidentified plant		0	5
Total plant volume		**83**	
Hymenoptera/Formicidea	Ants	5	69
Coleoptera/Coccinellidae	Lady Bird Beetle	3	43
Coleoptera/other	Beetles	4	49
Orthoptera/Locustidae	Grasshopper	6	14
Hemiptera	True Bugs	0	2
Archnomorpha/Acarina	Spiders/mites	0	4
Immature insects		1	28
Unidentified insects		0	5
Total animal volume		**18**	

that the lack of moist areas for foraging by broods may contribute to low chick survival and poor recruitment.

iv. Wintering

Winter diet in the United States is restricted to sagebrush which also provides thermal cover and concealment (Patterson, 1952; Remington and Braun, 1985; Wallestad et al. 1975). In some winters, snow cover may limit accessibility to some sagebrush stands, restricting use to tall stands or those on slopes with exposures to southwest winds. Sagebrush stands along drainages in Alberta are thought to be important for both winter and summer range (Vriend and Gudmundson, 1995).

c. Status of critical habitat

Except in general terms, critical habitat in Alberta and Saskatchewan lacks definition. For the purpose of recovery planning, it is assumed that all sagebrush/grasslands known to be used by sage grouse in the last 30 years, and still intact, may be critical if population recovery is to occur.

i. Land status

In Alberta, most of this habitat is on public land including 27 of the 34 known traditional leks. Of the 8 leks active in 1997 in Alberta, all but 1 were on public land under grazing disposition. Present Public Lands policies do not allow conversion of native prairie grasslands to crop production or tame pasture. These policies also do not permit eradication of sagebrush by chemical spraying, a practice which was formerly prevalent in the United States. Critical sagebrush habitat in southeastern Alberta is relatively secure from agricultural practices which would eliminate sagebrush stands.

The situation is similar in Saskatchewan. Weichel and Hjertaas (1992) reported 42 of 47 known lek sites were on Crown lands. These lands fall under a combination of provincial and federal jurisdiction. Provincial Crown lands are administered by Saskatchewan Agriculture and Food (SAF) whose current policy prohibits the breaking of native grassland where sage grouse leks occur. These lands are further protected by *The Wildlife Habitat Protection Act,* which restricts development of more than two million hectares of Crown lands with native vegetation. Parks Canada currently administers or plans to acquire portions of the Frenchman River valley from near Val Marie to the Montana border and the Killdeer badlands. Habitat on these lands is protected and lands which have previously been broken are being reclaimed to native grasslands. Prairie Farm Rehabilitation Administration (PFRA) controls and manages large pastures which contain a combination of native and tame species. As a partner in programs such as the Prairie Conservation Action Plan (PCAP) and the Representative Areas Network (RAN), PFRA is committed to the conservation of native rangeland.

ii. Habitat status

Comparison of measurements of sagebrush stands in Alberta between 1969 and 1995 and stands associated with active and abandoned leks in 1995 indicated little significant difference (Madsen, 1995). However, critical habitat may possess features other than sagebrush density and structure to which sage grouse may be responding. Madsen (1995) found that generally there was adequate brood-rearing habitat within the sage grouse range in Alberta. However, she noted the disappearance of wet meadow vegetation due to drought combined with livestock grazing. Aldridge (2000) agrees that important mesic areas containing succulent forbs may be lacking in the Alberta sage grouse range. During drought years, these mesic sites, which provide critical food resources for sage grouse broods, are also important sources of water, forage and shade for livestock. Timing of livestock use of these areas may result in direct competition between livestock and sage grouse. Increased use of grazing system management (deferred or rotational grazing) can reduce or minimize such competition.

Changes in cattle stocking rates, grazing regimes, stock watering developments and increases in cross fencing on public lands have occurred over the past 30 years of decline in sage grouse populations. Whether some of these changes have resulted in more intensive or more uniform grazing pressure in critical habitat needs to be examined.

Madsen (1995) and Dickinson (1969) evaluated floristic composition of sagebrush rangelands in southeastern Alberta. Comparing the data shows an apparent increase in percent frequencies of such plants as Prairie Selaginella (*Selaginella densa)*, Scarlet Mallow (*Malvastrum coccineum*) and Blue Grama (*Bouteloua gracilis)* on transects in 1995 compared to transects in 1969. Increases in these species suggest an increase in grazing intensity within some areas of critical habitat over that time period. However, there may also be other factors, such as climate change, which influence sagebrush/grassland communities.

While loss of critical habitat to cultivation does not appear to have been significant in the southeast corner of Alberta since 1968 when sage grouse were relatively abundant, loss of effective habitat by fragmentation and disturbance has been documented for some of the areas within that range. Oil and gas exploration have resulted in localized removal of vegetation for well sites, pipelines, pumping stations and access roads, as well as increased traffic, and mechanical and human activity (Dube, 1993; Aldridge, 1997).

d. Existing and future land-use conflicts

Since most sage grouse habitat exists on native prairie, the management of grazing lands is critical to the survival of the sage grouse. Most ranchers are cognizant of the fact that if they over-graze their pastures, their own economic welfare is in jeopardy. However, recent changes to the criteria for tax assessment in Saskatchewan (a shift from a production basis to a market-value basis) implemented in 1997 may have a bearing on the

intensity of land-use particularly that of native grass. The new tax assessment found some ranchers paying as much as 300% more in taxes on some of their grazing lands. Specifically, on lands occupied by Sage Grouse, increases ranged from 3% to 89%. This may impact management practices. Ranchers who previously may have moderately stocked their grazing lands could increase their herds to maximum capacity to compensate.

Under the present tax assessment system, no consideration is given for the presence of sage grouse leks or the conservation value of grazing lands. Tax changes and legislation pertaining to assessment can have tremendous impact on sage grouse habitat. Economic incentives can encourage the alteration and cultivation of native grass to the detriment of sage grouse habitat. Other land-use conflicts may include, but are not limited to, global climate change, tourism/ecotourism, industrial development, road construction, pesticide/herbicide use and habitat fragmentation.

The potential future effects of global climate change on the prairies are not yet known nor understood. Potential habitat may increase or decrease, range and behaviour of birds may also be affected by increasing temperatures and/or increasing number of extreme weather events. The potential permutations and ramifications of climate change are not predictable, but possible effects should be considered in all aspects of recovery planning.

Exploratory drilling, seismic activity, and well construction have increased within sage grouse habitat over the past 30 years. For example, air photo comparison (Figure 2) of the Manyberries Badlands of Alberta between 1952, 1988 and 1998 graphically illustrates the extent of oil and gas development over that period. Manyberries Badlands has one of the highest concentrations of wells and roads in the entire province (Alberta Environmental Protection, 1997). In that area, only 2 of the original 6 sage grouse leks remain active (Dube, 1993; Aldridge, 1998). Other areas in the southeast corner of Alberta have not been subject to this level of oil and gas activity. However, within Ranges 1 to 3, Townships 1 to 7, petroleum and natural gas subsurface sales in April and May 1997 alone, totaled 32,604 ha (Alberta Energy, 1997). Current economic and industrial trends point to continued oil and gas exploration and extraction. This industrial development will increase habitat fragmentation as a result of more road construction and pipeline development.

In Saskatchewan's current sage grouse range, petroleum exploration is still limited. However, increases in activity over the past 5 years would suggest that oil and gas drilling is expanding eastward from Alberta. Guidelines (Restoration of Saskatchewan's Agricultural Crown Rangelands, revised Sept 99) are in place to minimize surface disturbance to native prairie and to outline site restoration requirements. All oil and gas developments are reviewed jointly by Saskatchewan Environment and Resource Management and Saskatchewan Agriculture and Food and development on sage grouse leks would not be allowed.

Guidelines to minimize surface disturbance to native prairie in Alberta have been in place since 1992 and were updated in 1996. Recent placement of protective notations by Public

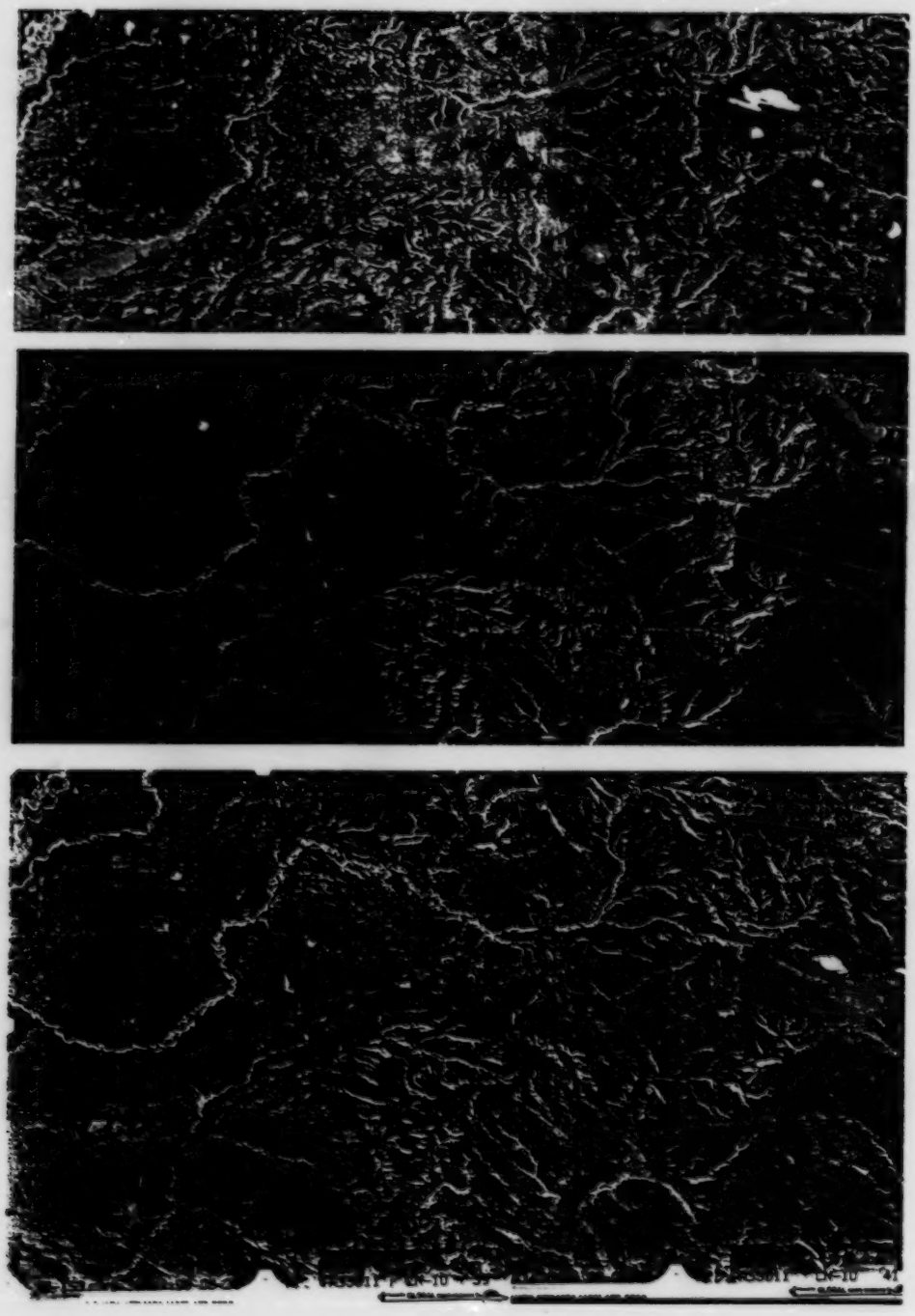

Figure 2. Aerial photography comparison of trail development in the Manyberries Badlands: 1952 (top); 1988 (middle); and 1998 (bottom)

Lands Division has restricted surface access to some sites and placed conditions on others. These measures have resulted in greater protection of critical habitat than was possible in the 1970s and 1980s. Policy and procedures to limit and mitigate damage by this industry are in place. Monitoring should continue and further mitigation should be explored. As well, wildlife managers, land managers, biologists, naturalists, range ecologists, and industry need to form partnerships or alliances to maintain sage grouse habitat.

Future economic and industrial development is hard to predict. Industrial expansion and development of geothermal wells, solar and wind energy fields may have an adverse effect on sage grouse habitat. Economic trends should be monitored and considered as they have a direct effect on environmental policy development. Generally as economic growth slows and recession approaches, public and government interest in ecological and environmental issues wanes.

There is continued growth in ecotourism and tourism within the sage grouse range, especially in the new Grasslands National Park. There is a growing interest in viewing spring sage grouse leks. How this viewing affects sage grouse is unknown. Birds that are disturbed do not return to the lek until the next day and it is thought that continual disturbance could result in site abandonment and may have detrimental impact on population status (Aldridge, 2000). Pressure and impacts from viewing will likely increase with the decreased abundance of opportunity and restricted range of sage grouse. For example, visitation to Grasslands National Park has increased roughly 25% each year and now stands at slightly less than 7000 visitors per year. Parks Canada does, however, have the ability to limit this industry for the benefit of sage grouse populations. Regulation of sage grouse tourism is already being considered in management planning.

C. Sociopolitical considerations

a. Public appeal/existence value

The sage grouse has high public appeal as an integral feature of the sagebrush-grassland prairie landscape. Land managers are keenly aware of sage grouse on their property, are protective of lek sites and exhibit strong concern about the welfare of the species. The sage grouse in southern Alberta and Saskatchewan is representative of a unique upland bird which is at the extreme northern limits of its natural range. The relatively constricted range and habitat of sage grouse in Canada enhances the value of the species as a natural component of wildlife diversity on the prairies.

Sage grouse provide ecotourism value with an increasing interest in viewing and photographing birds on the leks in the spring. In addition, with the increasing rarity of the species, more birders are searching areas where sage grouse may be seen to add this species to their "life list". Although formerly more widespread because of decreased sage grouse range, commercial ecotourism is now more concentrated in areas such as the Grasslands National Park in Saskatchewan.

b. Utilitarian value

The sage grouse is considered a game species in Alberta and was hunted in that province from 1967 through 1995. Hunting seasons were short (1 week) with small bag limits (1-2 birds). Hunter effort was low and although precise estimates of population size and harvest are not available, harvest rates were less than 10%. Although not in high demand as a game species, an abundant sage grouse resource does offer hunting opportunity for a unique upland game bird. In Saskatchewan, sage grouse were hunted in an unregulated system until 1938, after which the species received protection under *The Wildlife Act*.

The sage grouse habit of annually using traditional lek sites provides excellent opportunities for viewing and environmental education. Amateur and professional wildlife photographers frequent lek sites in pursuit of photo opportunities. The ecotourism industry provides guided tours and naturalists visit lek sites to view performing sage grouse. Educational institutions often incorporate sage grouse lek surveys into their natural sciences programs. There is considerable potential for inclusion of sage grouse as a species of concern in any educational program which focuses on the grassland prairie ecosystem. However, unrestricted and repeated access to sage grouse leks during the spring may interfere with breeding activity and could impact grouse use of the site.

c. Commercial or subsistence use

Prior to the arrival of Europeans, sage grouse were hunted for food. Their lekking behavior was likely a subject of cultural interest by aboriginal people. Settlers to the prairies hunted the bird for sustenance. The practice of subsistence hunting was likely limited due to the perception that the bird was not particularly palatable. Settlers then and ranchers today consider the bird a "poor man's food" because of the poor taste of the flesh. There is no other commercial or subsistence use of sage grouse in Canada.

d. Effects of human activities

Anthropogenic factors which could be impacting sage grouse populations include cultivation, grazing by domestic livestock, predation, use of chemical controls, petroleum development, vehicle collisions and interruption of fire cycles.

Long-term effects of grazing include changes in habitat structure and species composition on upland and riparian sites, spread of early seral exotics and degradation of riparian areas (Rasmussen and Griner, 1938; Patterson, 1952; Autenrieth et al., 1982; Klebenow, 1982 and 1985; Call and Maser, 1985). During times of drought, cattle are attracted to moist areas. Failure to reduce stocking rates during these periods may result in greater impact in the form of reduced vegetative cover (Aldridge, 1998). Damming or the impounding of watercourses for stock watering, irrigation development or habitat projects do help maintain wetland areas. However, such impoundment affects instream flows, on which sage grouse rely for survival, and intensifies livestock use near resulting wetland areas. Conversely, managed flows from impoundments could prove to be beneficial to sage grouse especially during drought periods.

Predation has been cited as the main factor associated with sage grouse nest and chick loss (Drut, 1992). The installation of raptor nesting platforms may have a negative impact on sage grouse survival (R. Russell, pers. comm.). Evidence suggests that the numbers of some predators, such as coyote, have increased in the southern prairies of Alberta (McAdam, 1997; Vriend and Gudmundson, 1996). The recent increase in ubiquitous coyote populations may be, in part, a result of the decline of the fur trade and subsequent lower price for furs. Domestic cats (*Felis domesticus*) (Girard, 1935) and the reintroduced swift fox (*Vulpes velox*) (Carbyn, 1996) are potential predators of sage grouse (Harris and Weidl, 1988; Vriend and Gudmundson, 1996). Power lines and poles create perches from which raptors can hunt sage grouse and sage grouse have been killed flying into power lines (Aldridge, 2000).

Cultivation of sagebrush grasslands has resulted in the desertion of leks (Dube, 1993; Aldridge, 1998) and has contributed to a decrease in available habitat (Dalke et al., 1963; Patterson, 1952; Wallestad and Pyrah, 1974). Patterson (1952) and Aldridge (2000) reported that birds foraging in agricultural fields could be subject to mortality and injury from farm equipment.

Oil and gas exploration and extraction near leks can disrupt breeding activity (Aldridge, 1998; Dube, 1993). Hydrocarbon developments also result in habitat alteration through the removal of vegetation and the development of roads (Aldridge, 1998; Drut, 1992). Roads increase the possibility of collision with vehicles (Patterson, 1952). Roads may also make leks more visible to humans resulting in possible abandonment if the birds are continually disturbed by onlookers (Aldridge, 1998).

The relationship between fire and range ecology is not well understood. The interruption of natural fire cycles is known to lead to increased canopy cover of sagebrush and has altered floristic composition (Kauffman, 1990; Winward, 1991). Wallestad (1975) found that sagebrush densities above 50% were not favourable for sage grouse. In some cases, the timing of fires is critical. For example, in southwestern Saskatchewan burning of vegetation to clear irrigation canals during the spring period may destroy nests.

Sage grouse range includes cropland where the use of pesticides may be lethal to birds (Blus et al., 1989). Upstream contamination of waterways by pesticides may have an adverse affect on sage grouse survival (Drut, 1992). Intensive chemical control of insects throughout the Great Plains may affect the availability of food for sage grouse chicks. The use of herbicides for shrub control can lessen available habitat for sage grouse (Drut, 1992). Although not illustrative or comprehensive in the description of the dispersal pathways, sublethal effects or indirect effects of pesticides, Table 4 provides some examples of common chemicals and their effect on sage grouse.
Several other factors may have an impact on sage grouse. Dog training can result in brood disruption and potential loss if the hen becomes separate from a portion of her brood. Short-term and long-term effects of weather patterns and climate change have not been evaluated.

e. Legal considerations

Legal status of the sage grouse has changed over the past few years and, at the present time, there are several legislative tools that can be used to control human impact on population and distribution. Human impact on sage grouse populations occurs both directly (disturbance) and indirectly (habitat loss).

Historically, populations of sage grouse were hunted in Saskatchewan and Alberta. However, sage grouse have not been hunted in Saskatchewan since 1938 and hunting in Alberta last occurred in 1995. Although past research has indicated that hunting

Table 4. Pesticides and contaminants in sage grouse

Toxin	Response	Cited in
Dissolved Solids over 3807ppm.	Toxic to sage grouse	Post, 1960. Cited in Autenreith, 1986.
2,4-D (2,4-dichlorophenoxyacetic acid)	Birds are not seriously harmed by inhabiting recently sprayed fields Sprayed areas restricted brood movements. Adults avoided sprayed areas except to strut.	Carr and Glover, 1970.
Dimethoate (Methamidophos)	Dimethoate apparently accounted for 20 deaths out of 31 radio-tagged sage grouse attributed to Dimethoate contaminated Alfalfa.	Blus et al., 1989.
radionuclide radiocesium (half-life 10-15 days)	Concentrations were higher in sage grouse summering near a liquid waste site than near a solid waste site or in control sites. (Health effects on grouse not noted.)	Connelly and Markham, 1983.
Toxaphene and Chlordane	Road-killed sage grouse contained enough insecticide-caused toxemia to kill them. Game bird mortality was 23.4% in baited plots.	Post, 1951.

sage grouse is sustainable, there is potential that hunting small, fragmented populations of sage grouse may contribute to suppressed population numbers. Sage grouse are currently protected in both Alberta and Saskatchewan.

At the present time, sage grouse in Canada are protected on several different levels and will likely continue to be afforded increasing protection as new legislation is passed. In 1998, COSEWIC listed sage grouse as endangered in Canada (listed as threatened in 1997). This status, coupled with cessation of hunting, affords sage grouse some protection from direct harassment and harm. Provincial wildlife regulations in Alberta and Saskatchewan provide protection from hunting and destruction or harm of nests. There is no international or national legislation which provides additional protection for sage grouse.

Sage grouse, in Canada, occur on a range of public and private lands. The majority occurs on public lands administered by the provinces of Alberta and Saskatchewan, on federal land administered by the PFRA and on federal land administered by Parks Canada.

Lands administered by Grasslands National Park in Saskatchewan may be some of the best protected sage grouse habitat. In a national park, habitat and ecological processes can be restored and managed to promote sage grouse populations. More protection will be provided to sage grouse and their habitat when park lands are gazetted. At the present time, Grasslands National Park lands are managed in accordance with park policy but are afforded protection under provincial Acts and Regulations. Grasslands National Park lands are to be gazetted and this will provide protection under the *National Parks Act*, a strong piece of legislation.

The PFRA administers large tracts of land as community pastures in Saskatchewan, and in Alberta, manages the grazing on portions of Department of National Defense lands at Canadian Forces Base Suffield. Recently a Memorandum of Understanding signed by the PFRA and the Province of Saskatchewan included PFRA lands in the Representative Areas Network. Though not legislated, this agreement provides some protection through habitat management. Saskatchewan Environment and Resource Management (SERM) acts as an advisor to PFRA. Management decisions on these lands are intended to benefit all interests while maintaining biodiversity and preserving rare and endangered species. Sage grouse habitat will be protected and perhaps enhanced with the signing of this agreement.

A good portion of the sage grouse population occurs on provincial land. Public lands in Alberta and Saskatchewan are used for grazing purposes and are managed by agriculture departments in each province. These lands are managed under various land management policies.

In October of 1996, Canadian provincial, federal and territorial ministers responsible for wildlife agreed in principle to a National Accord for the Protection of Species at Risk. Basic protection for endangered species in Canada would be met by satisfying 14 criteria

through the establishment of legislation and programs. Although Canada and the provinces continue to collaborate in the development of legislation pertaining to endangered species, there currently is no federal legislation to protect endangered species in Canada.

Sage grouse were listed as a game bird in Alberta but there has been no hunting season for sage grouse since 1995. As a game bird that is not hunted, sage grouse were protected against capture, killing or harming of individuals. In 1996, the Status of Wildlife in Alberta report (Alberta Environmental Protection, 1996) placed sage grouse on the 'blue list' and, by definition, they were identified as a species that may be at risk. Subsequent to a review of population status, in 1999 the Alberta Endangered Species Conservation Committee recommended that sage grouse be added to the list of endangered animals in regulations under the *Wildlife Act*. Early in 2000, sage grouse were listed as endangered under that Act. Listing of the species as an endangered animal affords the same protection as the status of a non-hunted game species but it adds protection of nests from disturbance, and places onus on Alberta Environment and the Endangered Species Conservation Committee with respect to species recovery planning. An endangered classification allows for significantly higher enforcement penalties. It also provides higher profile for the species and increases the priority and potential for habitat protection and other initiatives to maintain or enhance species survival.

Since 1938, sage grouse in Saskatchewan have been legally protected under *The Wildlife Act* relative to capture, killing, and possession. They were classed as threatened in 1987. This status did not provide them more legal protection; however, it was on the basis of this status for sage grouse that certain Crown lands were included under *The Critical Wildlife Habitat Protection Act* in 1988. This Act which was updated in 1991 to *The Wildlife Habitat Protection Act*, provides some protection to sage grouse habitat. Lands included in this Act cannot be sold or have native vegetation broken. However, it provides only limited protection from activities such as petroleum development, roads, pipelines, and other industrial activity.

In Saskatchewan, *The Wildlife Act* was amended in 1997 to list and protect wild species at risk. The sage grouse is designated as an endangered species and protected under *The Wildlife Act,* 1997 and the accompanying Wild Species at Risk Regulations (1999). It is illegal to kill, injure, possess, disturb, capture, harvest, traffic, export/import, genetically manipulate or interfere with, or attempt to do any of those things with sage grouse. The regulations also provide protection (disturb, remove, destroy) for sage grouse nests and leks.

It is evident that sage grouse are provided some protection from direct pressure such as hunting. This is important but may not be adequate to recover sage grouse populations in Alberta and Saskatchewan. Protection from direct pressure of disturbance and indirect pressures such as habitat loss, pollution and habitat alteration is only loosely provided, with responsibility diffused over many agencies. These losses are much less obvious and they are difficult to control or mitigate. It is unlikely that legislation alone will restore sage grouse populations. The cooperation of wildlife managers, land managers

agricultural and other policy makers and industry will be required to ensure maintenance of sage grouse.

D. Recovery potential

a. Potential causes of threat and likelihood of continued threat

Factors known to limit reproduction, survival, and expansion of some sage grouse populations are habitat degradation and conversion, human disturbance, development-related activities, inclement weather, predation, parasites, hunting and collisions. There may be other unidentified factors that may have a significant effect on sage grouse populations.

Eustace (1995) identified the conversion of sage grouse habitat in the United States as a major contributor in the decline in distribution and abundance of the species. In Canada habitat alteration is not presently viewed as a major factor as little sage grouse habitat is currently being converted. However, most of the sage grouse range is used for livestock production. Several studies have identified the importance of taller, residual grass cover in selection of nest sites by sage grouse (Wakkinen, 1990; Sveum et al., 1998; Aldridge, 2000). Heavy, intensive grazing by livestock could diminish the amount of residual grass cover available, precluding nest concealment from predators.

The effects of industrial activity are increasing. Traffic, roads, pipelines, power lines and other human disturbances from oil and gas developments decrease the chance for sage grouse recovery (Harris, 1996). Sage grouse avoid areas within half a mile (0.8 km) of power lines because they are used as hunting perches by raptors (Anonymous., 1996). Increasing power line presence may effectively fragment the amount of available habitat for sage grouse. Petroleum development puts pressure on sage grouse and their habitat in Alberta (Dube, 1985) and Saskatchewan by fragmenting habitats, increasing potential for mortality and causing disturbance to the grouse.

Predators may affect sage grouse populations differently depending on the size of the predator and distribution and abundance of other prey populations. Some mammalian species which formed a prey base for coyotes and other predators (ground squirrels, voles, mice and hares) are considered to have decreased since the 1980s (Houston, 1999; Harris and McAdam, 2000). In her investigation of small mammal abundance as a prey base for swift fox, Klausz (1997) indicates that small mammal trapping results were indicative of low population levels of all small mammal species. She concluded that small mammal density and species diversity was low in the Canadian Prairies during the 1995-1996 winter. Coyotes and other predators may be hunting sage grouse opportunistically in Canada. In Alberta there is an indication that coyote numbers may have increased substantially from the 1970s to the 1990s (Gudmundson, 1996). Raptors are also known predators of sage grouse. Skunks, weasels, raccoons, badgers, red foxes, ground squirrels and likely swift foxes are nest predators and some could also prey on sage grouse chicks. Potential impacts of predation on recovery efforts are unknown and must be examined in relation to low sage grouse population numbers.

The use of pesticides in general does not appear to be a significant factor because these products are not used to a great extent in the Canadian range of the sage grouse. However, some sage grouse, especially hens with broods, do utilize cultivated cropland during part of their life cycle (C. Aldridge, pers. comm.). Studies in the United States have identified mortality and injury resulting from insecticide poisoning. In particular, organophosphates which are contact and systemic insecticides are highly toxic to birds (Ali, 1996). Birds which nest or feed in hay fields may also be killed by haying equipment (Aldridge, 2000).

Birdwatching/photography is one of the fastest growing outdoor recreational activities related to wildlife. There is considerable interest in viewing sage grouse during the spring when males are actively displaying at leks. While increased societal interest in wildlife is considered a positive trend, the tendency for sage grouse viewers to approach too close to active leks can disrupt breeding activity. Repeated disturbance of birds at lek sites will interfere with mating and can result in abandonment of lek sites.

b. Current habitat recovery/protection efforts

i. Alberta

The majority of the sage grouse habitat occurs on public land administered by the Public Lands Division of Alberta Agriculture. This land is currently grazed at stocking rates determined by Public Lands agrologists. Some efforts have been made in recent years to reduce grazing levels to provide for sustainable management of public rangelands for all users, including habitat benefits for wildlife. The stocking rate and frequency required to adequately provide sage grouse with secure year-round habitat in this rangeland is yet to be determined.

Since the early 1980s, government policy has discouraged the cultivation of native grass prairie as well as the spraying of sagebrush on public land. For the majority of the remaining habitat, these concerns have not been significant. However, the recent exception is the potential for land sales and subsequent loss of management capability on or near 5 historic lek sites, one of which was occupied in April 1998. Efforts are currently being made to reverse the decision to sell these lands or, as a minimum, impose restrictions which will allow agricultural use with no conversion of native cover.

The oil and gas industry has played a role in the alteration of some sage grouse habitat in Alberta. Well site, road, pipeline, power line and building development have had the most significant impact in the area in recent years. Direct loss of habitat occurs with the physical presence of these developments. Indirect habitat loss is created by harassment, road kills, and noise, as well as through structures (buildings and power lines) providing enhanced raptor nesting and roosting habitat. Activities and structures on the landscape can decrease the quality and attractiveness of nearby areas for sage grouse, effectively fragmenting available habitat. Natural Resources Service reviews applications for development and

does recommend land-use guidelines which contain temporal and spatial activity restrictions around sage grouse leks. Specifically, seismic activity, surveying, and monitoring are prohibited within 500 m of leks from March 1 to June 15 and within 100 m from June 16 to February 29. Permanent or long-term developments are prohibited within 1000 m of leks year-round. These restrictions are only guidelines which have no legislative authority unless they are included as conditions of an industrial disposition approval. The only legislation which exists for sage grouse habitat protection applies to the nest. The Alberta Wildlife Act provides a maximum penalty of not more than $2000, or imprisonment of not more than one month, or both, for the destruction of a nest.

ii. Saskatchewan

Loss of Sagebrush habitat was almost certainly the cause of historical population losses, but since the late 1970s very little conversion of grassland habitat has occurred. Protection of the remaining habitat has been enhanced with the passage of *The Critical Wildlife Habitat Act* in 1984, revised in 1991 as *The Wildlife Habitat Protection Act*. These Acts prevent the breaking of native range on designated Crown lands. Most of the remaining native range on Crown lands within the 1988 range limit has been included in the Act.

Specific to sage grouse are restrictions implemented in 1994 which limit developments and disturbances to sage grouse lek sites. Currently, no developments are allowed within 500 m of lek sites and construction activities are not allowed within 1000 m during the breeding season (March 15 - May 15).

The recent development of Conservation Easement legislation has the potential to protect native vegetation on deeded lands. Under this legislation, private landowners could commit to protecting native vegetation on their property in return for financial compensation or benefits. The effectiveness and utility of this legislation in conservation of sage grouse habitat in Alberta and Saskatchewan will need to be monitored.

c. Current habitat management programs

i. Alberta

In January 1997, the Alberta Prairie Conservation Action Plan (PCAP), a provincial agreement involving multiple stakeholders, outlined a strategy for sound conservation practices to sustain the prairie ecosystem. The Special Places 2000 initiative identified the Manyberries Badlands area as a candidate site for protection; however, the local steering committee decided the area no longer meets the established criteria due to the high level of industrial development in the area (Figure 2). Management of sage grouse habitat in Alberta will continue to consist of gaining voluntary cooperation with Public Lands, Alberta Energy, local municipalities and industry in order to minimize the negative impacts of their activities.

Since the late 1980s, there has been some cooperative effort between Alberta Public Lands and leaseholders to reduce stocking rates on some rangeland in southeastern Alberta. The primary objective of this effort has been for sustainable management of public rangeland for all users and has resulted in improved habitat quality for ungulates. More recently, there has been some preliminary discussion with leaseholders regarding experimental reduction in stocking rates within critical sage grouse habitat. Further study into the relationship between livestock grazing intensity and the quality of sage grouse habitat components is needed. Research is also required to further define potential impacts of the oil and gas industry and potential mitigation techniques.

ii. Saskatchewan

Habitat requirements in the Silver Sagebrush portion of the range are poorly understood. Saskatchewan has adopted the position that all remaining sagebrush habitat will be protected from breaking and lek sites will be protected from developments in their immediate vicinity. Legislation is in place to protect areas on Crown land. Identification of important areas on private lands is currently under way. Once identified, attempts will be made to secure conservation easements on these areas.

The adoption of the Saskatchewan PCAP has resulted in an increased awareness of the value of native grassland. This plan was developed by a number of interest groups and land managers in Saskatchewan and has resulted in a heightened awareness of the participant's concerns and issues regarding native prairie.

E. Considerations affecting recovery

a. Recruitment rate

Sage grouse have a moderately high reproductive potential. Clutch size estimates from a radio-telemetry study in central Montana averaged 8.2, with yearlings having slightly smaller clutches (6.9) than adults (9.0) (Wallestad, 1975). However, mortality rates are also very high. Wallestad (1975) found that, on average, of all the eggs laid by hens, 56% of the potential chicks were not recruited into the fall population (44% survival from egg laying to September). He estimated that average annual mortality of sage grouse hens was 60-65% and was near 85% for juveniles. Very few birds lived past 3 or 4 years of age. With this level of mortality a complete turn over of the population would occur within 8 years. Wallestad (1975) calculated that for the Montana population he studied, the number of offspring surviving to the fall needed to be at least 3.6 young/female for the population to be stable. Johnsgard (1983) reports on the nesting success in several studies and found that of 503 nests, 47.7% were destroyed by predators and hatching success ranged from 23.7 to 60.2%.

During the late 1960s, work conducted in Alberta indicated that sage grouse hens exhibited nest success from 41-80% with recruitment rates of 1.7-2.3 juveniles/hen (Armstrong, 1968; Clewes, 1968; Armstrong, 1969). In a three-week effort to locate sage

grouse broods in Alberta during July 1985, Banasch (1985) found 29 broods with an average of 3.4 chicks/hen (Range 1-7). However, lone adults observed were not classified to female or male, and there is no measure of the proportion of hens which may have failed at nesting or lost entire broods after hatch. Aldridge (2000) found that clutch size in Alberta averaged 7.8 eggs, nest success averaged 46.2% and breeding success was 54.5%. This implies that breeding success is not limiting the population in Alberta. Currently, it is unknown to what degree the production and survival of sage grouse young is related to the decline of the Canadian sage grouse population.

b. Reproductive success and annual survival

There is little published information or data on the productivity, recruitment and survival rates of sage grouse in Alberta and Saskatchewan. Aldridge (2000) estimated that only 27.7% of nesting hens had chicks that survived to fledging and he suggests that low brood survival could be resulting in low reproductive success in Alberta. He also found that only 25% of birds trapped at leks during the spring were yearlings, further suggesting that recruitment from hatch to the breeding population the following spring is low. Generally, annual mortality rates are high in most grouse species and, in such species, high productivity rates normally offset high annual mortality. However, amongst grouse species, sage grouse are relatively long-lived (higher annual survival), have smaller clutches and lower recruitment rates (Patterson, 1952; Bergerud, 1988; Bergerud and Gratson, 1988). Thus, although the potential for sage grouse population recovery is still high with adequate habitat, recovery from low numbers is not as likely to occur as rapidly as with other grouse species.

There are many potential factors which could be affecting the reproductive success, annual recruitment and annual survival in the sage grouse population. The roles played by predation, habitat degradation, climate change, disturbance and native prairie plant succession as they relate to sage grouse ecology in prairie Canada are poorly understood.

c. Minimum viable population

Sage grouse researchers have suggested that a minimum of 500 breeding birds are required in the population for long-term maintenance of genetic variability (Anon., 1997; Braun, 1995; Franklin, 1980; Lande, 1980). Similarly, there is some suggestion that more than 500 breeding males are required for a sage grouse population to be considered secure (Anon., 1997). Populations with numbers below this level are thought to be susceptible to inbreeding depression and potential extinction. Although there is little documented scientific evidence to indicate these numbers are absolute minimums, it is obvious the sage grouse population in Alberta and Saskatchewan is dangerously close to minimum population size. Disjunct distribution of sage grouse, with very few leks and breeding birds in some portions of the range, further decreases the viability of some portions of the population.

d. Competing species/predators

Little is known about the effects of interspecific competition on sage grouse. Pronghorn antelope, white-tailed deer and mule deer share the sagebrush-grassland range with sage

grouse. There is no documented competition between these ungulate species and sage grouse. However, antelope do feed extensively on sagebrush over winter and it is conceivable that there may be competition for food resources during harsh winters. Further study of potential interspecific competition is required.

Only one other grouse species (sharp-tailed) frequents the sagebrush habitat preferred by sage grouse but, like other species of grouse, it appears to have declined in abundance since the 1980s (Eustace, 1996). Sharp-tailed grouse are not thought to compete directly for habitat resources. Hybridization of sage grouse and Sharp-tailed grouse has been recorded but is very rare with 7 known instances (4 from Saskatchewan and 3 from Alberta).

Pheasant range in Alberta and Saskatchewan overlaps with that of sage grouse. There is evidence that pheasants harass greater prairie chicken cocks and interfere with nesting by laying eggs in prairie chicken nests (Westemeier, 1985; Westemeier et al., 1998; Vance, 1977). There is no evidence of conflict between pheasants, or other non-indigenous avian species, and sage grouse in Alberta or Saskatchewan.

Changes to the predator complex may be a more important factor in sage grouse recovery than interspecific competition. The predator complex present in the Canadian prairies before European settlement consisted of grey wolf, grizzly bear, coyote, swift fox, red fox, bobcat, long-tailed weasel, black-footed ferret, badger, striped skunk and several species of avian predators (Bradley and Wallis, 1996; Fidler, 1967). Changes have occurred within the mammalian complex with four of these species being extirpated (although the swift fox has been reintroduced). Little change is thought to have occurred within the avian predator complex although common ravens have disappeared. Although sage grouse have co-existed with these predators for decades, little is known about the relative impacts of temporal changes to predator-prey relationships which may have occurred within the prairie ecosystem.

Coyotes, rather than wolves, are now the primary large predator on the prairies and the long-term impact of this change is unknown. Red Foxes have become more common throughout much of their former range although they are still relatively uncommon in the current sage grouse range. There has been little study of small mammal populations and the role these prey species may provide as a buffer to opportunistic predation of sage grouse by coyotes, foxes and raptors.

The establishment of raccoon populations within the range of sage grouse and the potential impact of raccoons cannot be overlooked. Raccoon populations appear to have expanded into the prairie provinces from east to west (Houston and Houston, 1973; Soper, 1946). Indicators suggest that exponential increases in raccoon populations occurred in Manitoba during the early 1970s, in Saskatchewan during the mid- to late-1970s, and had become well established in Alberta by 1982 (Lungle, 1991). Increases comparable to those in Manitoba and Saskatchewan were anticipated to occur in Alberta during the 1980s (Lungle, 1991). Raccoons have been implicated as an important predator of nests of waterfowl and other ground-nesting birds and may be responsible for suppressed bird productivity (Fritzell, 1978; Greenwood, 1981; Urban, 1970).

The swift fox has been reintroduced to portions of the prairies. Expansion of the range of raccoon and red fox has occurred in the last fifteen years and bobcat, skunk and weasel populations exist in this area.

Legislation in Alberta and Saskatchewan is liberal with respect to harvest and control of most mammalian predators. Coyotes, skunks and raccoons can be legally hunted year round without a license. Red foxes may be hunted at any time on privately owned lands in Alberta while in Saskatchewan they may be hunted year round without a licence. Bobcats and badgers are managed under fur harvest regulations with seasons but with no quotas. All raptors and swift foxes are protected from hunting and trapping. Within the Alberta range of sage grouse, weasels are protected from trapping in a 30-mile wide area adjacent to the Saskatchewan border while in Saskatchewan there is season but no quota. The effects of harvest and control measures on predator populations or predator-prey relations are unknown.

Although the impact of these predators on sage grouse has not been fully documented, there is some indication (C. Aldridge, pers. comm.) that loss of sage grouse to predators may be significant. The number and variety of predators in an area may have an influence on the status of sage grouse, especially if available cover in critical habitat is marginal. The presence of a variety of potential predators of sage grouse and their nests, within the sagebrush-grassland complex, increases the importance of quality sage grouse habitat which provides an abundance of cover and security from predation.

F. Summary

The sage grouse population in Alberta and Saskatchewan has been in a significant declining trend from the abundant numbers of the late-1960s. The current status of these birds, at the northern extent of sage grouse range in North America, is precarious. Little is known about the ecology of sage grouse within the Silver Sagebrush communities of the prairies and there is no obvious cause for population declines.

Considerable work and a collaborative effort by all land users in the Canadian range of sage grouse is required if these birds are to be restored to a viable, self-sustaining population status. Investigations into the biology of sage grouse and the factors limiting this population are critical and must be conducted to provide a greater understanding of the relationship between sage grouse habitat, human use of the landscape and the health of the birds. Greater insight into the health of the prairie ecosystem and the effect of the interrelationship of various ecological factors on sage grouse is required.

However, the quest to restore sage grouse numbers cannot wait for the answers that extensive, long-term studies may provide. An adaptive resource management approach is essential to restore sage grouse population numbers. Structured experimental manipulation of factors which may be adversely impacting the health of sage grouse populations and the prairie ecosystem is essential while investigations continue into the causes for decline. Ultimately, success in restoration of sage grouse numbers is dependent on a cooperative, collaborative effort by wildlife enthusiasts, industry, agriculturists, land managers, and all land users.

III. STRATEGIES

A. Increase productivity of sage grouse.

Although the precise cause of population decline in sage grouse is unknown, it is suspected that low productivity may be one factor.

a. Assess and monitor productivity

An understanding of sage grouse productivity and the role it plays in population status is required to determine if it is a limiting factor. Survey techniques to measure sage grouse productivity need to be designed and utilized throughout the Canadian sage grouse range. Components of annual productivity (nest success, egg success, hen success, re-nesting effort, brood size, brood survival and recruitment rates) must be examined to identify potential limiting factors.

i. Conduct annual surveys to determine productivity in specific nesting areas.

ii. Assess productivity factors for sage grouse.

iii. Determine causes of differential productivity between areas and time periods.

b. Determine factors that limit productivity

If productivity is a problem, it may be a result of low production (genetic, intrinsic) or high mortality (extrinsic). If it is low production, attempt to determine what is causing depressed production. If it is high mortality, investigate and determine major mortality factors.

i. Investigate and determine habitat conditions conducive to high nest success.

ii. Investigate food requirements for nesting hens and broods.

iii. Determine mortality factors and assess mortality rates for nesting hens and broods.

iv. Investigate contaminant levels in sage grouse habitat and assess the potential impact on productivity

c. Implement appropriate actions to increase productivity pending results from A(a) and A(b).

Mitigation initiatives to increase productivity potential will need to be developed depending on the results of assessment of productivity and the factors which may limit productivity.

B. Increase annual survival of sage grouse

Annual survival of sage grouse and survival by various components of the flock through various seasons of the year need to be examined to determine if excessive mortality at any stage of growth or any period of the year is a controlling factor.

a. Determine causes of mortality that affect annual survival rates.

Little is known about sage grouse mortality factors. A greater understanding of predator-prey relationships, mortality factors and mortality rates at various life stages is needed to assess the importance of mortality factors.

i. Investigate causes of mortality for adult males and females which may be limiting factors during each season.

ii. Investigate causes of mortality for females and broods which may be limiting factors during each season.

iii. Investigate causes of mortality for post-fledging juveniles which may be limiting factors during each season.

b. Implement appropriate actions to increase survival rates pending results from B(a).

C. Conserve and manage sage grouse habitat

There is little documented knowledge of the characteristics of habitat deemed to be important or critical to propagation of sage grouse in the Silver Sagebrush/grassland complexes common to southwestern Saskatchewan and southeastern Alberta. Characteristics of habitat which are critical to sage grouse at various stages of their life cycle need to be understood to ensure that habitat initiatives will provide optimal benefits to sage grouse.

a. Define, identify, conserve and enhance critical lek, nesting, brood rearing and winter habitat used by sage grouse.

Characteristics of habitat types preferred by sage grouse at various times of the year, and the interrelationships between these habitat types, are not clearly defined. Public (landowners, land managers, and other land users) involvement and participation in reporting sightings of sage grouse leks, nests, broods and winter locations should be encouraged. Intensive searches of sage grouse range are required to assess critical habitat parameters throughout the year and the relationships between these habitat types. Abandoned habitat should be assessed for seasonal deficiencies which may limit use by sage grouse. Critical habitat must be protected and secured. Land-use practices and other factors detrimental to maintenance of quality sage grouse habitat need to be identified. Working cooperatively with land managers and other land users, initiatives need to be developed to enhance and maintain an abundance of high quality habitat, on private and public lands, throughout the range of sage grouse.

i. Establish public reporting system for sage grouse lek, nesting, brood and winter locations.

ii. Conduct searches/surveys for active leks, nests, brood rearing and winter-use areas throughout sage grouse range.

iii. Document habitat characteristics of lek, nesting, brood-rearing and winter-use areas and the interrelationship between habitat types.

iv. Investigate habitat parameters (lek, nesting, brood rearing and winter-use) in areas of abandoned leks.

v. Investigate use of remote-sensing data systems to identify potential lek, nesting, brood-rearing and winter habitat.

vi. Map critical lek, nesting, brood rearing and winter habitat areas.

vii. Identify critical lek, nesting, brood rearing and winter habitat which must be protected, secured or enhanced.

viii. Identify land-use practices which are detrimental to provision of quality lek, nesting, brood rearing and winter habitat.

ix. Develop cooperative initiatives to protect lek sites and lek, nesting, brood rearing and winter habitat on public lands.

x. Develop cooperative initiatives to protect lek sites and lek, nesting, brood rearing and winter habitat on private lands.

xi. Develop cooperative initiatives to enhance and improve the quantity and quality of lek, nesting, brood rearing and winter habitat.

b. Determine the historical rate of loss of critical sage grouse habitat and the associated causes of loss.

There is little obvious evidence of causes for declines in sage grouse populations in Alberta and Saskatchewan. The work outlined in C(a) will prove beneficial in defining habitat characteristics for maintenance of sage grouse. Clear definition of habitat requirements for various life stages will provide a basis for examination of historical losses and the causes of the loss of these habitat types. Retrospective examination of historical losses will assist in mitigating past losses and preventing losses in the future.

i. Define characteristics of critical sage grouse habitat.

ii. Investigate use of remote-sensing data systems to document historical losses of critical habitat.

iii. Develop cooperative habitat enhancement initiatives aimed at restoring historic sage grouse habitat on public and private lands.

c. Identify land-use policies and practices which limit the quality of, or destroy sage grouse habitat.

Land-use policies or practices which destroy or degrade the quality of lek, nesting, brood rearing or winter habitat for sage grouse must be documented. Support programs which directly or indirectly provide agricultural or industry incentives for activities which are detrimental to maintenance of sage grouse habitat should be identified. The cumulative effect of human land-use patterns on survival of viable sage grouse populations should be assessed. Programs, policies and practices which are not detrimental to sage grouse should be promoted.

i. Examine potential impact of agricultural support programs on sage grouse habitat.

ii. In cooperation with the agricultural community, promote programs which protect, enhance or maintain healthy sagebrush/grassland complexes.

iii. Encourage cooperative agricultural programs which decrease or limit cultivation of sagebrush/grasslands.

iv. Examine practices and policies with respect to industrial activities on lands in the sage grouse range.

v. In cooperation with industry, implement practices which are not detrimental to sage grouse habitat or sage grouse use of habitat.

vi. Examine and assess the cumulative effects of the impact of all aspects of human land-use patterns on sage grouse habitat.

vii. Inform land managers of sage grouse preferred habitat and habitat conditions and encourage management to maintain such habitat conditions.

D. Monitor population status.

Monitoring of sage grouse populations has been limited to discontinuous and inconsistent lek surveys during the spring breeding period. Comprehensive surveys to monitor sage grouse populations at various stages of the life cycle are needed to provide a better understanding of the life requisites for species maintenance.

a. Conduct standardized annual surveys to monitor spring breeding populations.

An annual survey which effectively monitors the spring breeding population is the minimum requirement for determining population status and trends. Annual spring lek surveys, which encompass four replicate surveys of each lek, should be operational commitments. A means to correlate lek survey data to the total population size should be refined.

i. Conduct surveys of all known active leks to document number of males present.

ii. Survey known inactive lek sites to determine if sites are being utilized.

iii. Search vicinity of recently inactive lek sites to determine if alternate lek sites have been selected.

iv. Develop a means to correlate spring lek survey data to size of the total sage grouse population.

b. Search for new lek sites.
Active leks are the core activity area for sage grouse and are considered an indication of the health of the population. In addition to surveys of known active and inactive lek sites, a survey technique should be developed to effectively search for previously unknown lek sites.

i. Develop a standardized system for landowners, land managers and other land users to cooperatively report the presence of sage grouse or leks on their lands during the spring.

ii. Conduct searches of all potential breeding habitat for active leks in the spring.

c. Develop a survey system to monitor winter population status.
Surveys of leks provide one measure of population status but there is no established relationship between number of males in the spring and the size of the post-fledging winter population. Winter surveys have not traditionally been conducted for sage grouse and little is known about the status of populations in winter. Survey techniques for monitoring winter population size should be developed.

i. Develop a standardized system for landowners, land managers and other land users to cooperatively report presence of sage grouse on their lands during winter.

ii. In accordance with strategies C(a)(iii) to C(a)(v), conduct aerial surveys of potential winter habitat for presence of sage grouse.

E. Develop and maintain public support through education.
Local landowners are consciously aware and protective of sage grouse on their lands. However, they and the broader general public will benefit from increased knowledge respecting the plight of sage grouse, habitat requirements for sage grouse within the prairie ecosystem and the role which the public can play in maintenance of populations.

a. Increase public awareness of the need for initiatives to protect and increase sage grouse populations.

Public support for initiatives to recover sage grouse habitat and populations can be enhanced through dissemination of information on the plight of the species, its status, its habitat and the role the public can play in population maintenance. Landowner cooperation and assistance can be increased through provision of information and direct involvement in monitoring and enhancement.

i. Prepare and distribute a Canadian sage grouse information pamphlet.

ii. Investigate opportunities for using, and use media (talks, television and other media) to raise the awareness of sage grouse within target audiences.

b. Use information and extension to encourage protection and enhancement of habitat.

Land managers within sage grouse range play a pivotal role in maintenance or enhancement of habitat so that population recovery is possible. Extension and information dissemination intended specifically for the land manager would promote cooperative participation by land managers in sage grouse recovery.

i. Develop and distribute informative brochures and pamphlets describing the types of habitat that are critical to sage grouse.

ii. Work with landowners and land managers to develop land management actions which could be practiced to enhance sage grouse habitat.

iii. Meet and discuss sage grouse habitat concerns and issues with land-use policy makers.

iv. Solicit support from land management agencies to include information on sage grouse in newsletters, etc.

c. Use information and extension to decrease disturbance of sage grouse.

Although the impact of direct or indirect disturbance of sage grouse is unmeasured, there is sufficient reason to suspect that substantial disturbance can deter bird use of lek sites and other critical habitat impeding breeding success and annual survival. Liaison with industry (petroleum, ecotourism) and wildlife viewing enthusiasts is required to minimize the potential impact of disturbance on sage grouse.

i. Develop and distribute informative brochures and pamphlets regarding minimizing disturbance at lek sites.

ii. Work with the petroleum industry to cooperatively develop policies and practices which minimize industry disturbance impacts on sage grouse.

iii. Work with the ecotourism industry to develop policies and procedures, which minimize industry impacts on sage grouse.

iv. Investigate the option of developing a wildlife viewing facility at one lek site to provide viewing opportunities with minimal disturbance of birds.

v. Review existing legislation and policies and determine the need for change to minimize the impacts of disturbance on sage grouse.

vi. Monitor and assess any potential adverse impact of research on productivity or survival of sage grouse.

This Recovery Strategy identifies the need for collection of substantial information and data about sage grouse in Alberta and Saskatchewan. Collection of such information will require extensive and intensive research working directly with the birds in many instances. In recognition of the low number of birds in the population, there is a critical need to ensure that any research conducted on sage grouse has no adverse impact on their survivability.

IV. FROM STRATEGY TO ACTION

A. Planning activities

For completion of recovery planning for sage grouse, the Sage Grouse Recovery Strategy needs to be translated into well-focused action plans which identify implementation activities and schedules. Specifically, the cause(s) of the population decline need to be determined and appropriate interventions to reverse the decline need to be developed. Simply monitoring populations and protecting current habitat and local populations are unlikely to be successful since there is no obvious cause for the decline, and the decline has been rapid. Failure to act will likely result in the extirpation of another Canadian wildlife species. Projects and initiatives aimed at sage grouse recovery should be fast-tracked as much as feasible.

Four action themes are outlined below. These are related groups of strategies and it is the recommendation of the Sage Grouse Recovery Team that separate but coordinated working groups be organised around each theme to develop Sage Grouse Recovery Action Plans as quickly as possible. The Sage Grouse Recovery Team has initiated formation of Working Groups for each of these action themes. The Recovery Team will coordinate the activities and recommendations of the Working Groups, will review proposed Action Plans and coordinate implementation within the two provinces. Each Working Group will be responsible for developing an Action Plan for their particular action theme. The Working Group will decide the relative merits of developing a joint Alberta-Saskatchewan Action Plan, or separate Action Plans for Alberta and Saskatchewan. Working Groups are advised to consider the recommendations contained within this Sage Grouse Recovery Strategy when developing Action Plans. Further, the groups are advised to consider initiatives and actions for recovery of sage grouse within the comprehensive context of enhancement of the prairie ecosystem. Working Groups should complete their Action Plans by April 1, 2001.

Basic principles of adaptive resource management, or learning-by-doing, will be used to guide all stages of action planning. Ongoing Working Group efforts to develop Action Plans should not preclude immediate action to assist sage grouse. Experimental efforts to provide ecological benefits to sage grouse during the action plan development phase are encouraged.

B. Working group action themes

a. Research

Since there is no obvious cause for the decline of sage grouse in Canada, there is a need to generate hypotheses for the decline. An important first step is to conduct retrospective research. Action Plans should include compilation of all historical information on land use within sage grouse range and correlation of this information with the temporal and spatial pattern of population decline. This investigation may determine what, if any, patterns exist so that the additional knowledge can be used to guide the recovery planning process.

There are a large number of strategies in this document which relate to determining habitat requirements, life table statistics and assessing the effects of different land-use practices. These activities will require the use of similar research techniques such as radio transmitter monitoring of sage grouse. There are many facets of study recommended in the strategies,

which can be accomplished concurrently within one large experimental framework. For example, within a research program examining the effects of grazing management on sage grouse habitat and productivity, much of the basic data on habitat requirements and life table information could be collected. Effort should be devoted to maximising the information return while minimising disruption to the birds. While considering the need for extensive research into sage grouse ecology, consideration should also be given to collaborating with other research into other species or facets of sagebrush-grassland ecology to build towards a holistic understanding of a functioning prairie ecosystem. One of the first activities under this action theme should be convening a series of workshops to develop a comprehensive, multi-faceted research framework.

b. Habitat and species conservation and restoration

The Working Group for this action theme will develop an Action Plan to coordinate the protection of existing habitat and populations using government policy, legislation and collaboration with all land users. As much as possible, guidelines for industrial, agricultural, ecotourism and public land-use activities within sage grouse range should be consistent between provinces. In collaboration with the Research Working Group, this group will identify and develop cooperative initiatives to protect, secure and enhance habitat which is considered critical to various life stages of sage grouse. This Group will also identify areas of degraded historical critical habitat which should be high priority for restoration, enhancement and securement of native plant species.

c. Population monitoring

A number of strategies make recommendations pertaining to monitoring of the status of sage grouse populations. Ongoing monitoring of population status at various times of the year is required to further understand population dynamics and, ultimately, evaluation of success of the population recovery efforts will be based on estimates of the sage grouse population obtained through monitoring. This Working Group will develop an Action Plan related to monitoring of the status of sage grouse, both in terms of overall population status and as an evaluation tool for overall recovery efforts. The group should strive for annual monitoring initiatives which are conducted consistently using standardised protocols.

d. Communication and education

Several recommended strategies relate to communication and education initiatives. This Working Group will develop an Action Plan which will define the need for, and the most appropriate avenue to develop communication and education products for a wide variety of target audiences from the general public to an assortment of land users. Communication and education will also be closely coordinated with action planning by the other Working Groups with respect to aiding in the accomplishment of their specific objectives. Securement of funding for recovery efforts will require a strong communications effort.

C. Considerations for working groups

1. There is a desperate need for committed long-term government funding for dedicated sage grouse research and co-ordination staff. This capacity currently does not exist in either Alberta or Saskatchewan. Initial funding, in the order of $200,000, should be secured to facilitate and support ongoing efforts of the Sage Grouse Recovery Team, the Working Groups, research, and implementation of preliminary, experimental management efforts which can be implemented immediately.

2 Recovery of sage grouse populations cannot be accomplished by government alone or solely with government funding. Successful recovery is only feasible with the cooperation and collaboration of affected landowners, land managers, industry, conservationists and the public. Government funding available for sage grouse recovery should be considered as one contribution to a broader effort by all the partners involved in the recovery effort.

3. Communication and cooperation with Montana with respect to sage grouse management has been minimal even though the Canada-Montana populations may be contiguous. Opportunities to collaborate with Montana in sharing of knowledge and management of sage grouse should be pursued.

4. There are only a few areas where sage grouse currently occur in Canada and many of them occur on privately managed land. Publicly managed areas such as community pastures and Grasslands National Park, which provide greater land management flexibility, may be very important for some of the initial experimental habitat management. However, management strategies developed on these lands must be applicable to privately managed lands to ensure perpetuation of sage grouse throughout its range.

5. Many of the issues related to sage grouse status and recovery are common to other prairie wildlife species. The time may be appropriate to consider sage grouse recovery within the context of a comprehensive prairie ecosystem recovery plan. Efforts should be made to coordinate sage grouse recovery efforts with other initiatives or programs relevant to a sustainable management of the prairie ecosystem.

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VI. APPENDICES

Appendix 2. History of male sage grouse occupancy on known leks in Saskatchewan

LEK #	NAME	1987	1988	1989	1994	1995	1996	1997	1998	1999	2000
1	MORGAN HILL					NEW	6	0	0		0
2	MORGAN CREEK	10	14		0	0	0	0	0		0
3	SUNKEN HILL	7	0		0	0	0	0	0		0
4	HELLFIRE	4	0a		0	0	0	0		0	0
5	WHETHERALL	40	31		3	0	0	0	0		0
6	FIREGUARD						10	7	22	19	27
7	ROCK CREEK SATELITE	0	1		0	0	0	0		0	0
8	ROCK CREEK	38	72		17	11	15	11	16	10	14
9		0	6		0	0	0	0			0
10		18	0		0	0	0	0			0
11		11	27		0	0	0	0			0
12					0	0	0	0			0
13	MEYRONNE PASTURE				0	0	0	0			0
14		NEW	50		0	0	0	0			0
15		NEW	7		0	0	0	0			0
16		NEW	27		0	0	0	0			0
17	SOUTH GILLESPIE	11	24		0	4	0		2		1
18		19	17		0	0	0				
19		0			0	0	0				
20		3	0a		0	2	0				
21		0	13				0				
22	DIXON Y	22	31		14	16	18	11	21	19	17
23		0				0	0				
24					0	0	0				
25	POLICE COULEE	52	54		0	3	12	5	14	11	5
26		0			0	0	0				
27		7	0		0	0	0				
28		23			0	0	0				
29	SNAKE PIT	23	22		0	16	10	12	11		5
30	DOG TOWN CAMP	18	26		0	5	3	0	0	0	
31		11	0a		0	0	0				
32		11			0	0	0				
33		0			0	0	0				
34		5	6a		0	0	0				
35	WEST FLAT	0	23a		3	0	5	0	16	16	15
36		0	0			0					
37		1	44		0	0	0				
38		27	31		1	3	0				
39	WHITE RANCH		25		4	3	3	2	0	0	0
40	ALLEMAND RANCH		6		0	2	2	2	0	0	0
41			17		1	0	0				
42		10	9a		0	0				0	
43	MUNDELL CREEK	48	0a		10	20	9	3	3	5	7
44			12		0	0	0			0	0
45		6	0a		0	0				0	0
46		6			0		0			0	0
47		0	5	5	0	0	0			0	0
48		0	5	0	0		0			0	0
49		22	13	0	0	0	0			0	0
50		0	13	0	0	0	0			0	0
51	MIDDLEFORK	21	41	23	14	7	7	4	7	8	9
52		23					0			0	0
53	MERRYFLAT			9			4	4	2	0	0
54		7	0	0			0			0	0
55		0	0	6						0	0
56		11	5	0	11	6	0			0	0
57				22						0	0
58	SPANGLER WEST	0					8	0	8	13	12
59				7						0	0
60				22						0	0
	LEKS CHECKED	44	39	12	42	41	47	21	27	30	41
	LEKS OCCUPIED	33	31	7	10	14	14	10	11	8	10
	TOTAL MALES	556	593	94	81	98	104	61	122	101	112
	MALES/LEK	18	21.2	13.4	8.5	7.5	6.9	2.9	11.1	12.6	11.2